BIOSORPTION OF COPPER, CHROMIUM AND ZINC FROM TEXTILE WASTEWATER USING EUCHEMA SPINOSUM (RED ALGA)

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Oleh sebab pertumbuhan pesat ekonomi di era ini, banyak industri telah dibina dalam menyediakan masyarakat dengan bekalan dan keperluan. Air menjadi perkara yang paling penting kerana setiap pembangunan menggunakan air sebagai sumber utama walaupun untuk industri tekstil. Walau bagaimanapun, banyak air sisa yang dihasilkan semasa pembuatan menyebabkan risiko kepada manusia dan benda hidup yang lain. Oleh kerana rawatan air memerlukan pengeluaran bahan kimia dalam menyelesaikan masalah air sisa, kajian ini telah menggunakan alga macro yang berkesan dan boleh didapati secara meluas dalam sistem akuatik sebagai biosorben dalam mengeluarkan logam berat dari air sisa sebenar. Kajian ini bertujuan untuk meminimumkan penggunaan kimia dalam rawatan air yang menggunakan alga makro semulajadi sebagai biosorben melalui kaedah mudah iaitu kaedah penjerapan. Makro alga adalah bahan biologi yang mempunyai potensi untuk mengumpul logam berat ke permukaan alga makro. Proses biosorpsi ini dapat mengurangkan jumlah logam berat di dalam air buangan tanpa sebarang bahaya kepada manusia dan alam sekitar. Macro alga adalah biomas yang tidak toksik yang menyediakan nutrien dan benefisiari lain kepada industri makanan. Dalam kajian ini, sampel alga merah dan sampel efluen tekstil memilih untuk mengkaji keberkesanan alga merah sebagai biosorben dalam mengeluarkan logam berat dari air sisa. Sampel alga makro merah yang dikenali sebagai Euchema Spinosum dikumpulkan dari Kunak, Sabah manakala sampel air sisa tekstil dikumpulkan dari Tenun Diraja Pahang yang terletak di Kuantan, Pahang. Satu dos optimum dan masa hubungan telah dikenal pasti semasa penyelidikan untuk menyiasat penjerapan maksimum tembaga, kromium dan zink. Dos yang dipilih yang digunakan dalam eksperimen ialah 0.25 g, 0.5 g, 0.75 g, 1.0 g, 1.25 g dan 1.5 g. Selepas itu, masa hubungan terpilih untuk ujian percubaan adalah 1 jam, 8 jam, 16 jam, 24 jam, 32 jam, 40 jam, 48 jam, 52 jam dan 58 jam. Peralatan makmal yang digunakan untuk mengukur kandungan logam berat adalah Spektrofotometer UV-VIS. Faktor pencairan 50 ml air suling digunakan untuk mencairkan sampel air buangan tekstil kerana ketebalan warna berasal dari pewarna yang digunakan dalam pembuatan tekstil. Spektrofotometer UV-VIS tidak dapat mengukur nilai julat berat logam berat jika kandungan logam berat terlalu tinggi. Pengenceran sampel diperlukan dalam eksperimen ini untuk menampung peralatan makmal. Seterusnya, penghapusan peratusan setiap logam berat telah dikira. Keputusan dan perbincangan telah diperiksa dan direkodkan. Dos yang optimum untuk ketiga-tiga logam berat ini adalah 20 g / L. Masa hubungan optimum yang dijumpai untuk penyingkiran Tembaga ialah 24 jam manakala masa hubungan optimum untuk Chromium dan Zinc adalah 40 jam. Kapasiti penjerapan tertinggi Chromium, Zink dan Tembaga adalah 92.67%, 90% dan 76% masing-masing. Selain itu, kandungan awal Copper menunjukkan nilai tertinggi diikuti oleh Chromium dan Zinc. Selepas itu, Tembaga adalah kapasiti pengambilan logam yang paling berat untuk biosorpsi berbanding dengan Chromium dan Zink. Kesimpulannya, Euchema Spinosum didapati sangat berkesan dalam menghilangkan Chromium dan Zink tetapi kurang berkesan dalam mengeluarkan Tembaga dari air sisa tekstil.

ABSTRACT

Due to the rapid growth of economy in this era many industries were build up in providing the community with supply and need. Water became the most crucial thing since every development is using water as the main source even for the textile industry. However, the abundant of waste water produce during the manufacturing has cause the risk toward human and other living things. As water treatment need the production of chemical in solving waste water issue, this research has come out to use the cost effective and widely available macro alga in aquatic system as biosorbent in removing heavy metals from the real waste water. This research was intended to minimize the use of chemical in water treatment which using the natural macro alga as biosorbent through simple method that is adsorption method. Macro alga is a biological material that has a potential to accumulate the heavy metals onto the surface of the macro alga. This biosorption process can reduce the amount of heavy metals inside the waste water without any harm to human and environment. Macro alga is a non-toxic biomass that provide nutrients and other beneficiaries to the food industry. In this research, a sample of red alga and a sample of textile effluents was chose to study the effectiveness of red alga as biosorbent in removing heavy metals from waste water. The sample of red macro alga known as Euchema Spinosum was collected from Kunak, Sabah while the sample of textile waste water was collected from Tenun Diraja Pahang located at Kuantan, Pahang. An optimum dosage and contact time were identified during the research to investigate the maximum adsorption of copper, chromium and zinc. The selected dosages used in the experiment are 0.25 g, 0.5 g, 0.75 g, 1.0 g, 1.25 g and 1.5 g. After that, the selected contact times for the experiment chose are 1 h, 8 h, 16 h, 24 h, 32 h, 40 h, 48 h, 52 h and 58 h. The laboratory equipment used to measure the heavy metals content is UV-VIS Spectrophotometer. A dilution factor of 50 ml of distilled water is used to dilute the sample of textile waste water due to the thickness of color came from dye used in manufacturing of the textiles. The UV-VIS Spectrophotometer cannot measure over range value of heavy metals if the content of heavy metals is too high. Dilution of sample is necessary in this experiment to accommodate the laboratory equipment. Next, the percentage removal of every heavy metals were calculated. The results and discussions was examined and recorded. The optimum dosage for these three heavy metals is 20 g/L. The optimum contact time found for Copper removal is 24 hours while the optimum contact time for Chromium and Zinc is 40 hours. The highest adsorption capacity of Chromium, Zinc and Copper is 92.67%, 90% and 76% each. Besides, the initial content of Copper shows the highest value followed by Chromium and Zinc. After that, Copper was the least heavy metal uptake capacity for the biosorption compare to Chromium and Zinc. In conclusion, Euchema Spinosum is found very effective in removing Chromium and Zinc but less effective in removing Copper from the textile waste water.

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LIST OF SYMBOLS

Cu	Copper
Cr	Chromium
Zn	Zinc
Pb	Lead
$Cu(NO_3).3H_2O$	Copper Nitrate
Cd	Cadmium
COD	Chemical Oxygen Demand
MCL	Maximum Contaminant Levels
Euchema Sp.	Euchema Spinosum
NaOH	Sodium Hydroxide
UV-VIS	Ultraviolet Visible Spectrophotometry
rpm	Revolution per minute
mg	Milligram
g	Gram
L	Litre
FTIR	Fourier Transform Infrared Spectroscopy
mm	Millimetres
HNO3	Nitric Acid
ml	Millilitres
h	Hour

LIST OF ABBREVIATIONS

Cu	Copper
Cr	Chromium
Zn	Zinc
Pb	Lead
$Cu(NO_3).3H_2O$	Copper Nitrate
Cd	Cadmium
COD	Chemical Oxygen Demand
MCL	Maximum Contaminant Levels
Euchema Sp.	Euchema Spinosum
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UV-VIS	Ultraviolet Visible Spectrophotometry
rpm	Revolution per minute
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FTIR	Fourier Transform Infrared Spectroscopy
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HNO3	Nitric Acid
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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Water treatment is significant in daily life. Water is the main source to human but untreated water is not able to keep human are protected from health diseases. Water treatment is the process to treat water or improve the quality of water to make it acceptable for specific end use. Water treatment involved technologies, science, engineering, business and art. Nowadays, there are variety of industries that used water treatment to avoid the existence of non-useable waste water. There are several ways to treat or disinfect the water. In our water treatment system, chlorination is the most widely used method to disinfect the water. It is a most reactive elements and can be found dissolved in sea water or salty lake. The chlorine is produce through chemical oxidation. Since it is very reactive and corrosive gas, chlorine need a proper precaution in the production.

This research is using macro algae as bio sorbent in the real waste water. The main purpose of the use of macro algae is to produce a clean and healthy water same as the chlorine function. Macro algae by definition are unicellular algal species that can survive individually or in chains or clusters. Macro alga exist in both suspended forms (that free-float in a water body) and attached forms (that adhere to a submerged surface) and are one of the most important groups of organisms on the planet. Macro algae cultures offer a modern solution of wastewater tertiary treatment together with the production of potentially valuable biomass, which can be used for several purposes (biogas and biofuel production, composting, as animal feed or in aquaculture and production of fine chemicals).

The macro algae use the nutrients (inorganic nitrogen and phosphorus) in order to grow and have the capacity to remove heavy metals and some toxic organic compounds

(dyes and antibiotics) and to reduce, also, the chemical and biochemical oxygen demand. In conclusion, water treatment has been studied over decades and there are many ways in water treatment. This research is done to produce a clean and healthy water that are acceptable for specific uses such as drinking and cook. This bio sorbent method is capable to prove an effective alternative to the waste water treatment system. Bio sorbent by chance is the method of absorbing any contaminant such as heavy metals in the real waste water.

1.2 Problem Statement

Nowadays, there are many development of industry from various types. This development gives a rapid growth of economy, technologies, food and beverages, and textiles. However, there must be risks to everything that give profit and beneficiaries to the human kind. Water are the most common sources that having pollutant issue especially industries that used water as main sources. It is not a crime to produce wastewater during manufacturing but how the waste water treated is the main issue. There are several industries that do not treat the wastewater well which cause the water pollution. The issue that arise when the water is not treated properly is what will happen to human health and other living things.

The untreated water may contain any numbers of contaminants such as bacteria, viruses, parasites, heavy metals, pesticides, fertilizers, and human and animal waste. This contaminated water can attack the human health and cause to death. To prevent any negative issues water is significant to treatment. Due to some circumstances, such as the cost of water treatment that quite crucial become the main purpose to abandon the wastewater treatment. This study was undergoing to used other option to treat water such as using macro algae as bio sorbent. Since algae are easy to acquire, this biological material can help to reduce the cost of wastewater treatment. In addition, the natural source of macro alga is a better choice for the treatment instead of producing more chemical reagent to solve the water issues.

1.3 Objectives

i. To determine the characteristic of the real waste water.

ii. To study the effectiveness of bio sorbent for the removal of heavy metals.

1.4 Scope of Research

This research is proposing to do a water treatment of real waste water using Euchema Spinosum which is a red macro alga. The real waste water is collect from a textile industry located at Tenun Diraja Pahang, Kuantan Pahang. This study used to investigate the level of heavy metals content such as Copper, Zinc and Chromium in the real waste water. The samples are collected and tested in laboratory before use to the next step of treatment. The parameter to be cover in this study are the optimum dosage, optimum contact time and Copper, Zinc and Chromium content in the samples of real waste water.

In addition, this research is to study the effectiveness of macro alga as bio sorbent in treating the real waste water. The most effective macro alga from screening process is choose to be produce as bio sorbent. Macro alga are reacted as bio sorbent to the real wastewater. Instead of using macro alga to produce activated carbon for water treatment, this study is conduct to use macro algae as natural bio sorbent to the real wastewater. The macro alga is tested to absorb heavy metal such as Copper, Zinc and Chromium in the real wastewater. The macro algae will be process into small particles and mix to the samples. The content of heavy metals in the samples will be observed and analyses to prove the effectiveness of bio sorbent in reducing the heavy metals content in the samples.

1.5 Significance of Research

This research is done to prove the effectiveness of macro alga as bio sorbent in water treatment. Algae can easily be found in the aquatic system and there is variety type of algae. This research can maximize the use of algae and gain the benefits of algae toward the waste water treatment system. Macro alga also can be other alternative of water treatment of real waste water.

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